

**PLASMA SCIENCE ADVANCED
COMPUTING INTITUTE**

**PROGRAM ADVISORY COMMITTEE
MEETING**

W. M. TANG and V. S. CHAN

24-25 May 2006

PSACI Program Advisory Committee

William Kruer, *PAC Chairman*, Adjunct Professor of Applied Science, UC Davis

James Callen, Professor Emeritus of Engineering Physics, U. of Wisconsin

Ronald Davidson, Professor of Astrophysical Sciences, Princeton U.

Patrick Diamond, Professor of Physics, UCSD

James Drake, Professor of Physics & Astronomy, U. of Maryland

Raymond Fonck, Steenbock Professor of Engineering Physics, U. of Wisconsin

*Brian Gross, Deputy Director, Geophysical Fluid Dynamics Laboratory

*Robert Harrison, Chief Scientist for Computational Chemistry, ORNL

Russell Hulse, Nobel Laureate, Professor of Science & Math Education, U. of Texas @ Dallas,
and Distinguished Laboratory Fellow, PPPL

Bruce Langdon, Plasma Theory Group Leader, AX Division, LLNL

*Kai Li, Fitzmorris Professor of Computer Sciences, Princeton U.

*William McCurdy, Senior Faculty Scientist, LBNL

*Michael Norman, Professor of Physics and Center for Astrophysics and Space Sciences, UCSD

*Steven Orszag, Professor of Mathematics and Chairman, Applied Math Department, Yale U.

*Malcolm Stocks, Corporate Fellow & Co-Director of Computational Science
& Materials Research Institute, ORNL

* *Non-Plasma Science Members*

GENERAL CONSIDERATIONS

- (1) **Challenge** is for Fusion SciDAC projects to effectively utilize terascale computing to produce significant *new scientific insights/conceptual breakthroughs* that are well appreciated by the FES as well as the general scientific community

- (2) Need to clearly demonstrate how the partnerships with OASCR (e.g., SciDAC CS & Applied Math Centers) are helping to deliver *new capabilities* -- *collaboratively building the necessary software, visualization, networking, etc. to enable effective use of hardware to accelerate scientific progress*

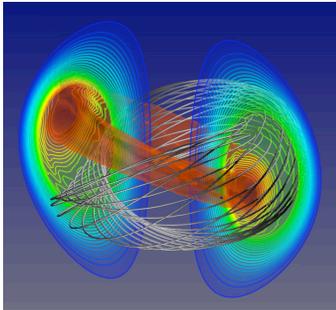
- (3) Fusion SciDAC Program should demonstrate how it can enable for the US -- *a meaningful scientific leadership role and cost-effective participation on major new facilities located abroad such as EAST, JET, ... leading to ITER*
 - impact real decision-making in the large “scientific options space”
 - harvest knowledge from major US investments abroad

SPECIFIC CONSIDERATIONS IN ASSESSING ACCOMPLISHMENTS OF FES SCIDAC CENTERS

- How well has each project made tangible progress toward achieving its scientific targets with respect to clear deliverables in the past year?
- What were the *major impediments* to more timely progress in each center/project?
- How have high-end computing resources been effectively utilized to accelerate progress toward achieving these scientific goals?
 - *Path from terascale to eventually petascale computations?*
- Are productive *collaborative activities evident* within each project and with other SciDAC activities (including relation between projects and enabling CS & Applied Math resource centers?)
- What are some future topics with great potential for *significant SciDAC scientific achievements*?
 - Where are the associated computational science opportunities?

Present Fusion SciDAC Projects

Extended MHD Modeling



N=1 Plasma Instability

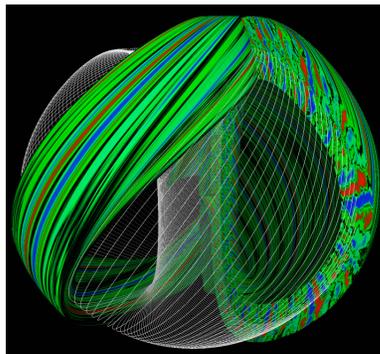
*PPPL, NYU
U. Wisconsin, SAIC,
U. Colorado, MIT,
General Atomics,
LANL*

Wave Plasma Interactions

*ORNL, PPPL, MIT,
Lodestar, CompX*

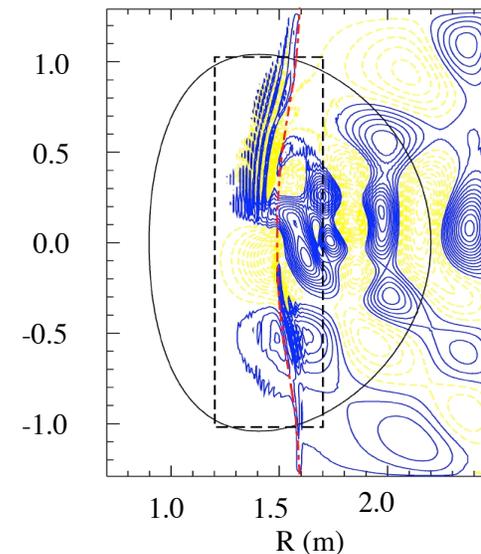
Plasma Microturbulence

*PPPL, UC Irvine,
U. Colorado, UCLA*



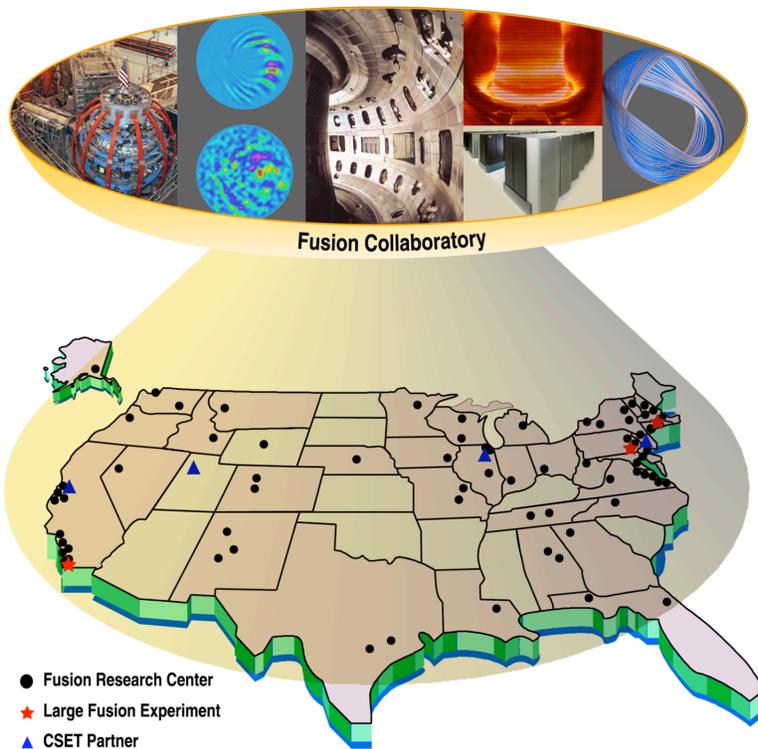
**Turbulent Eddies in
Plasmas**

Wave Field



THE NATIONAL FUSION ENERGY SCIENCES COLLABORATORY

(involves 40 US sites in 37 states)



• Collaboratory Goals:

- enable more efficient use of experimental facilities by developing more powerful *between pulse data analysis*
- enable *better access by researchers* to analysis & simulation codes, data, and visualization tools
- create *standard tool set* for remote data access, security, and visualization

• Collaboratory Partners:

- **3 large fusion experiments***

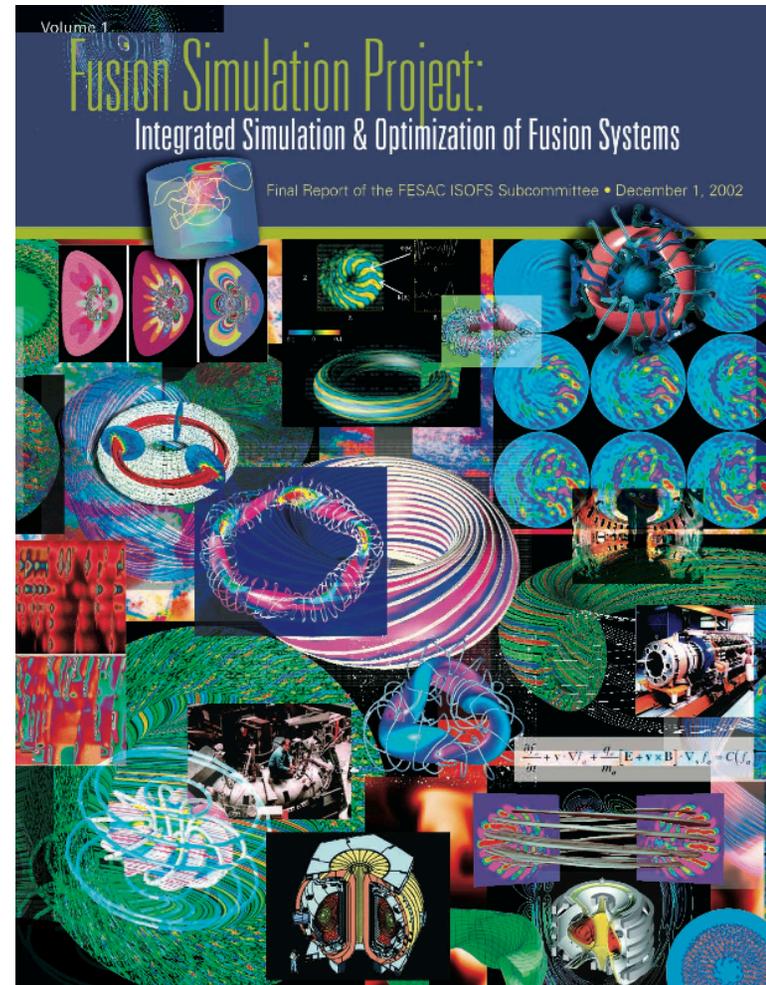
* C-MOD, DIII-D, NSTX

- **4 computer science centers****

** ANL, LBNL, Princeton U., U. of Utah

INTEGRATED MODELING CHALLENGE: “Fusion Simulation Project” (FSP)

- Targeted \$20M/yr Program with start-up SciDAC FSP “prototype” activity in FY ‘05
- \$2M per year (over 5 years) provided jointly by OFES & OASCR within SciDAC Program for “Proto FSP’s”:
 - Center for Edge Simulations of Plasmas (PI: C. S. Chang, NYU)
 - Center for Simulations of Wave Interactions with MHD (PI: D. B. Batchelor, ORNL)
- Plan to leverage results from *SciDAC Program* for fundamental physics foundations and on Applied Math/Computer Science communities for needed algorithms
- *Fusion Simulation Project is a potentially valuable US contribution to ITER*



CHARGE FOR PSACI PAC MEETING

- Evaluate substantive progress made by each project toward the scientific/computational goals and deliverables targeted by the Fusion SciDAC Centers in the second of a 3-year funding period with respect to:
 - *New scientific insights/conceptual breakthroughs* enabled by the FES SciDAC Program
 - *Demonstrated utilization of terascale computing capability*
 - *Likelihood of timely delivery of reliable computational modeling capabilities addressing burning plasma physics issues relevant to ITER*
- Assess progress made on recommendations from ‘05 PSACI PAC Report and specifically on “Cross Benchmarking of Turbulence Codes”
- Provide initial *impressions of the promise of the initial progress and the scientific achievability and relevance of the targeted goals over the course of next 5 years* for the two \$2M SciDAC FSP (Fusion Simulation Project) Proto-type Centers & a new Edge Simulation Laboratory Project (supported by OFES & OASCR)

**PLASMA SCIENCE ADVANCED COMPUTING INSTITUTE (PSACI)
PROGRAM ADVISORY COMMITTEE
AGENDA**

WEDNESDAY, MAY 24, '06

9:00 AM -- 10:00 AM

Welcome from Rob Goldston followed by

CLOSED SESSION:

PAC discussions of charge, updates on the latest developments/issues at DOE and for PSACI involving the PSACI PAC, DOE Management, R. Goldston, W. Tang, and V. Chan

10:00 AM -- 10:15 AM

Coffee Break

10:15 AM -- 12:15 PM

OPEN SESSION

Presentations from Fusion SciDAC PI's

*SciDAC Center for Extended MHD Modeling (S. Jardin, PPPL)

30 minutes presentation; 30 minutes discussion

*SciDAC Center for Simulation of Wave-Particle Interactions (P. Bonoli, MIT)

30 minutes presentation; 30 minutes discussion

12:15 PM -- 1:15 PM

LUNCH

1:15 PM -- 3:30 PM

OPEN SESSION

Presentations from Fusion SciDAC PI's (continued)

*SciDAC Center for Gyrokinetic Simulation of Turbulent Transport (W. Lee, PPPL)

30 minutes presentation; 30 minutes discussion

Progress on Cross-Benchmarking of Turbulence Codes (J. Mandrekas, OFES)

15 minutes presentation; 30 minutes discussion

3:30 PM -- 3:45 PM

Coffee Break

3:45 PM -- 5:00 PM

CLOSED SESSION

PAC begins formulation of recommendations and poses additional questions to SciDAC PI's

5:00 PM -- 6:00 PM

OPEN SESSION

Additional questions and requests for clarifications from PAC to PI's

7:00 PM

Dinner for Meeting Attendees

THURSDAY, MAY 25, '06

9:00 AM -- 10:15 AM

OPEN SESSION

Responses from Fusion SciDAC PI's to PAC questions & associated discussions

10:15 AM -- 10:30 AM

Coffee Break

10:30 AM -- 12:00 PM

Integrated Modeling Presentations: Initial Progress & Plans for new SciDAC FSP (Fusion Simulation Project) Proto-type Centers & for new Edge Simulation Laboratory (project supported by OFES and OASCR)

* SciDAC Center for Simulation of Wave Interactions with MHD (D. Batchelor, ORNL)

15 minutes presentation; 15 minutes discussion

* SciDAC Center for Edge Simulation of Plasmas (C. S. Chang, NYU)

15 minutes presentation; 15 minutes discussion

* Continuum Gyrokinetic Approach for Edge Kinetic Simulations (Jeff Candy, General Atomics)

15 minutes presentation; 15 minutes discussion

12:00 PM -- 3:00 PM

CLOSED SESSION (extending over lunch)

PAC drafts report with comments/recommendations

3:00 PM -- 3:30 PM

DEBRIEF SESSION & ADJOURNMENT